

# DEVELOPMENTAL BIOLOGY 7

## PARTHENOGENESIS

**Parthenogenesis** is the process of development of female gamete into embryo without fertilization. Parthenogenesis literally means a virgin birth; in biological terms, it simply means that an unfertilised ovum will give rise to a fully-functioning adult. Parthenogenesis is a type of asexual reproduction and applies only to animals (the botanical counterpart is called apomixes). It was first discovered by Owen 1849. The individual so formed is called Parthenot.

A species can be **obligately parthenogenic** (can't reproduce sexually at all) or **facultatively parthenogenic** (has the ability to switch between sexual and parthenogenic reproduction). In all, there are about 2000 species recorded to reproduce at least facultatively parthenogenetically under natural conditions and many more definitely exist, but remain unobserved/unsampled.

Of the vertebrates, parthenogenesis has never been reported for mammals; bird eggs reported as being of parthenogenic origins never hatch. It's only found in several unique fish, amphibians and lizards. In those, it is present due to polyploidy and hybridisation. At the cellular level, the difference between parthenogens and sexuals is that in the latter, meiosis is followed by fusion of a male and female gamete. In parthenogenesis, meiosis is changed so that only one particular set of chromosomes is transferred in a non-random fashion.

Parthenogenesis may be differentiated into two types, Natural Parthenogenesis and Artificial Parthenogenesis.

**Natural parthenogenesis:** It is also called virginal reproduction and regularly occurs in life cycle of lower forms. In some species it is the only mode of reproduction while in others it is a mode of reproduction as well as the mechanism of sex determination. Adults produced in this way contain a haploid or diploid chromosome number. It is of two types, complete and incomplete type.

**Complete Parthenogenesis:** In certain species of aphids and phyllophods which sporadically consist of exclusively of males or of females, males occur rarely therefore every individual arises from an unfertilized egg. It constitutes a highly distinct type of genetic system in which sexuality has been entirely abolished and recombination of genes is no longer possible.

**Incomplete Parthenogenesis:** In bees, wasps and aphids one or more parthenogenic generations alternate with a bisexual one usually in an annual cycle. It is also known as partial or cyclic parthenogenesis.

Natural Parthenogenesis is also divided into Haploid and Diploid Parthenogenesis.

**Haploid Parthenogenesis or Arrhenotoky:** In Hymenoptera, Coleoptera, Thysanoptera, Rotifera and Arachnida male arises from the unfertilized egg and are consequently haploid, while females from fertilized eggs and so are diploid.

**Diploid Parthenogenesis or Thelytoky:** Here the reduction division is abortive and diploid eggs are formed which develop without fertilization. This is again of two types:

- **Meiotic Parthenogenesis:** In some Crustaceans, Hymenoptera and Lepidoptera during **oogenesis**, development of eggs takes place following some anomaly in reduction division thereby diploid ovum is produced which develop into diploid individual.
- **Ameiotic Parthenogenesis:** In some Crustaceans and Molluscs the first meiotic division which is a reduction division is completely suppressed and only a mitotic division resulting in diploid eggs which develop into new individuals without fertilization. It is also known as apomeiotic parthenogenesis.

In some tubellarians, nematodes and earthworms even though the spermatozoa penetrate the egg it disintegrates without fusing with the egg nucleus. This process is said to be gynogenesis or pseudo fertilization.

**Artificial Parthenogenesis:** Here artificial stimulants are used to induce parthenogenesis in the egg. The agents causing the development of egg trigger off the action similar to that of spermatozoan. Various agents are found to be effective stimulants like hypertonic or hypotonic sea water, various salts, weak organic acids, fat solvents, alkaloids, temperature and electric shocks, by ultraviolet light, warm or cold water, pricking, injecting leutinising hormone etc.

**Significance:** Parthenogenesis is a means of reproduction, sex determination, higher multiplication, avoid sterility in races, helps transfer mutant characters, maintain similarity in population and produce polyploidy animals.